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Network psychometric-based identification and structural analysis of a set of evolved human motives

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ABSTRACT

Establishing a limited set of motives characteristic of the human species has been a goal in psychology since the beginning of the discipline. This paper uses a network-based analysis of previously published psychometric data to establish the existence of a pre-defined set of human motives. The set was derived by using evolutionary theory to identify what sorts of goals humans need to achieve to survive and reproduce in the niche our species evolved to fill. The analysis reported here is based on responses obtained from an on-line sample of 510 representative residents of the United Kingdom to 150 items. Analysis shows that all fifteen of the identified motives can be isolated, that they show expected relationships to one another (based on common functionality), and that differences in attentiveness to motives by gender reflect traditional gender-based role-play during human evolution, while differences by age are consistent with expectations from life history theory. The reduced set of 45 items identified by a genetic algorithm-based analysis could form the basis of a psychometric scale. Knowing the set of motives behind goal-directed behaviour should prove a significant boon to a wide variety of psychological applications, including human relations, educational strategies, marketing and behaviour change.

1. Introduction

The question of what motivates human behaviour has long intrigued psychologists. Despite extensive research spanning decades, consensus remains elusive regarding the specific motives that drive behaviour and their number. Researchers have proposed various systems of human motives, reflecting diverse theoretical perspectives. Some have proposed a hierarchical structure of needs (Maslow, 1943), while others tried to identify a central motive driving an individual's behaviour, such as achievement or power (e.g., Baumeister & Leary, 1995). At the same time, attempts were made to systematize different approaches into one theory (e.g. Desmet & Fokkinga, 2020).

However, many existing theories primarily offer proximal explanations, neglecting the evolutionary underpinnings of human psychology. Several attempts have been made to incorporate an evolutionary perspective into the derivation of human motivations– for instance, by identifying the universal requirements of human life to which every individual must attend (Schwartz, 1992), or constructing an update to Maslow's hierarchy of needs (Kenrick et al., 2010), or arguing that a mental mechanism should be associated with each type of natural selection process (e.g., sexual selection, reciprocal altruism, and parental investment) (Bernard et al., 2005). Each of these strategies produced a very different set of motives, with different ranges: Schwartz's model begins from conscious goal-seeking by individuals or groups and so includes a wide variety of end-goals, from "freedom" to "a world at peace". Kenrick et al.'s list of motives is restricted to only the social aspects of human life (Kenrick et al., 2010), while Bernard's list is broader, but includes a number of conscious self-control-based goals.

A different approach was taken by Aunger and Curtis (2013), who proposed to derive a comprehensive and overarching set of human motives directly from evolutionary theory. According to this perspective, motives can be understood as psychological mechanisms that generate behaviours designed to tackle tasks essential for survival and reproduction within the human niche. In essence, the human lifestyle is inherently connected to achieving a range of evolutionary goals. Consequently, behaviour can be categorized, as in behavioural ecology, according to whether it primarily supports reproductive efforts (e.g., through mating activities) or centres on the survival and growth of the body (somatic needs), thereby laying the groundwork for future reproductive opportunities. Within these two main kinds of objectives, more situated kinds of goals can also be identified, depending on whether they produce improvements in the individual's own body, their social world,

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ecological environment, or their ability to understand their world more accurately. In this way, fifteen motives were established that have different evolutionary origins and functions. The array of motives includes *environmental* motives (Hoard, Create), *physiological* motives (Fear, Disgust, Hunger, Comfort), *reproductive* motives (Lust, Attract, Love, Nurture), *psychological* motives (Curiosity, Play), and *social* motives (Affiliate, Status, and Justice). Thus, each distinct human motive catalyses specific types of behaviour (Aunger & Curtis, 2008) (see the definition of all motives in Table 1).

The foundational premise of this approach is that motives are evolutionary adaptations designed to influence behaviour in ways that enhanced the fitness of our ancestors. Therefore, if these mechanisms trigger specific behaviours, they can be identified using standard psychometric techniques (Aunger et al., 2021). The initial attempt to develop a tool assessing human motives proved relatively successful, with satisfactory fit indices. However, the motive labelled 'Comfort' did not emerge as a robust factor from the psychometric analysis. Furthermore, it was observed that some motives tend to reinforce each other in driving behaviour (e.g., Status and Attract, Play and Curiosity), while others appear to be antagonistic (e.g., Status and Affiliation) (Aunger et al., 2021). The aim of this study is to reanalyse the structure of this set of items using network psychometrics, which may help in selecting more appropriate items for assessing human motives. Additionally, there is a need to further investigate the Comfort motive, which was not clearly identified in the previous study.

Any type of analysis based on data collected in an abstract context (such as an on-line questionnaire – the case to be analysed here) will of necessity not be measuring variation in the degree of 'active' motivation at the moment of being an informant, but rather cause the informant to reflect on their more general tendencies to behave in certain ways. As a consequence, psychometric analysis must rely on a more distal interpretation of its findings with regard to behavioural causation. In our analysis, we therefore treat motives as relatively stable individual differences, aligning with the view that certain motivational triggers are consistent enough across different contexts to be considered 'trait-like.' This perspective is grounded in the notion that while motivation can indeed be dynamic and context-dependent, there are underlying predispositions that influence how individuals respond to various situational cues. These predispositions are what we refer to as 'motives'.

Our focus on distal causation—viewing motives as relatively stable traits or predispositions less disposed to respond to immediate circumstances — allows us to examine how individual differences in these motives can predict behaviours and preferences across a range of situations. However, we do not discount the importance of proximal causes and the dynamic aspects of motivation. Rather, our analysis complements these perspectives by providing insights into the more enduring aspects of motivation that may serve as a foundation upon which situational factors exert their influence. By treating motives as relatively stable traits, we aim to capture the consistency with which individuals are motivated by certain factors, such as the need for comfort, excitement, or social connection. These 'trigger' differences, we argue, are stable enough to be predicted by demographic variables like gender and age, and understanding these differences can offer valuable insights into how people navigate and adapt to their environments.

In psychological research, factor analysis has traditionally been employed to uncover latent constructs through correlations among observed variables. However, latent variables are often mistakenly treated as real causes of traits, when in fact they are typically statistical abstractions that may not reflect actual, distinct phenomena (Revelle, 2024). This misinterpretation can lead to conflating ultimate and proximate causes, particularly when reflective models are applied to constructs that are inherently functional in nature (Gruijters & Fleuren, 2018). Network psychometrics offers a more direct and conceptually appropriate approach by examining relationships between variables without assuming underlying latent variables (Golino & Epskamp, 2017).

Network models are also better suited to real-world data, accommodating the complex, interrelated nature of psychological phenomena that often do not conform to the assumptions required by latent variable models, such as issues with cross-loadings or correlations between residuals. These challenges, which can complicate and sometimes invalidate traditional latent variable models, are more naturally addressed in network models. In network analysis, variables are treated as nodes, and edges represent the strength of their direct interactions, making this method particularly useful for understanding complex item relationships (Golino & Epskamp, 2017). This network-based approach is particularly advantageous for high-dimensional data, such as the use of 150 items to capture the central evolutionary functions of 15 postulated motives. It allows us to model and interpret motives like Comfort in a way that reflects their real-world interconnectedness without over-reliance on assumptions typically associated with latent variable models. Our method reveals multiple, interrelated clusters and intricate item relationships, offering deeper insights into these motives.

2. Methods

2.1. Item development

Aunger et al. (2021) developed 150 items intended to capture the central evolutionary functions of the 15 postulated motives. These items were generated through extensive brainstorming sessions, followed by preliminary data collection and analysis. The items, crafted to closely reflect the essence of each motive, were discussed among the research team and refined through consensus. Each item was phrased as a statement indicating a behavioural pattern, a preference for certain rewards, or the emotional impact of specific behaviours. Respondents rated these statements on a 5-point Likert scale, ranging from 1 = *strongly disagree* to 5 = *strongly agree*, with the order of items randomized to the survey but consistent across participants.

Table 1
A list of evolved human motives.

Environmental	Physiological	Reproductive	Psychological	Social
Hoard – aiming to always possess the necessary resources for any circumstance.	*Fear* – aiming to prevent physical harm or accidents.	*Lust* – seeking a genderual relationship with another individual.	*Curiosity* – seeking knowledge about what is going on.	*Affiliate* – aiming to act in ways that encourage others to include you in their community.
Create – striving to enhance one's physical environment.	*Disgust* – aiming to avoid exposure to contaminants or pathogens.	*Attract* – aiming to arouse genderual attraction.	*Play* – pursuing opportunities to acquire new skills.	*Status* – aiming to gain esteem and respect from others.
	Hunger – seeking nourishment through food or drink.	*Love* – aiming to sustain a pair-bond.		*Justice* – aiming to hold accountable those who engage in anti-social behaviour.
	Comfort – seeking relief from physical discomfort.	*Nurture* – seeking to promote the interests of one's offspring/gene copies.		

2.2. Data collection procedure

Data collection, supervised by the London School of Hygiene and Tropical Medicine and approved by its Ethics Committee (internal application number 17858; approval date: November 25, 2019), and conducted by the Qualtrics company (www.Qualtrics.com), employed a rigorous methodology to ensure the representativeness of the sample. Participants were recruited from a large, empanelled population, with quotas set to match age, gender, and regional distributions according to the most recent UK census data. Data collection occurred in two phases between November and December 2019, using an online questionnaire that included a consent form (which required electronic compliance), 150 item statements, and sections for demographic information. Participants were compensated £4.00 for their participation.

The dataset analysed by Aunger et al. (2021) and reused here thus includes a total of 510 participants characterized by a diverse age and regional distribution within the United Kingdom. Specifically, age groups were represented as follows: 11.4 % of participants are aged 18–24, 17.2 % are 25–34, 25.2 % are 35–49, 23.5 % are 50–64, and 22.7 % are 65 or older. Gender representation is nearly balanced, with men constituting 48.8 % and women 51.2 % of the sample. This dataset is available on the Open Science Framework (OSF) website at https://osf.io/njkcq/. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

2.3. Analytic strategy

Network psychometrics based on the Extended Bayesian Information

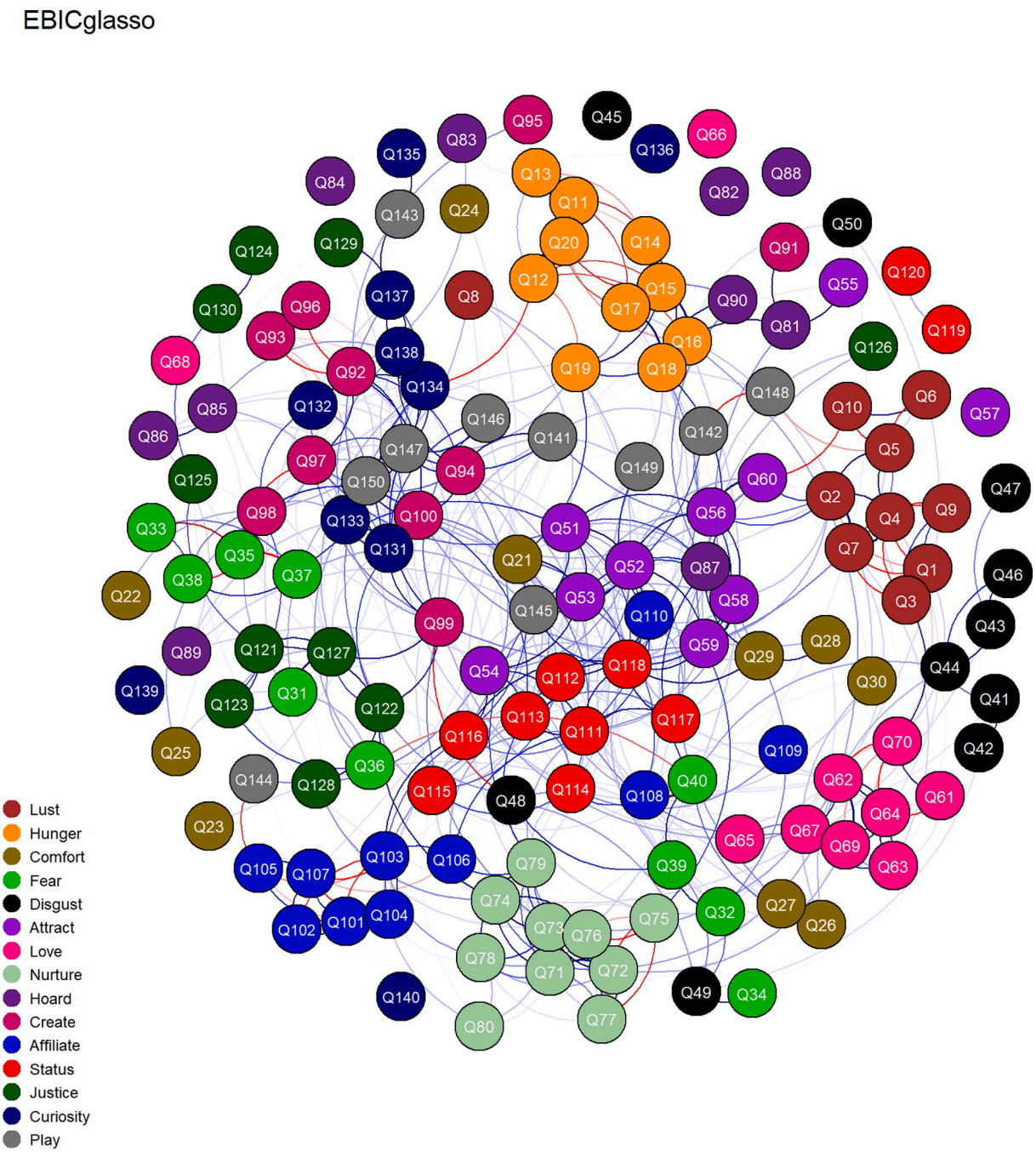

Fig. 1. Network plot of 150 items by evolved human motives ($N = 510$).

Criterion Graphical Lasso (EBICglasso) have been increasingly utilized to assess relationships within psychological constructs. EBICglasso is a statistical method used in network analysis to explore the conditional dependencies among variables in psychological data (see Supplemental Material for description). We applied both the unthresholded analysis, which considers all potential connections, offering a comprehensive view, and the thresholded analysis, which filters connections based on their strength, focusing on the most influential and statistically significant links. This dual approach simplifies the network visualization and interpretation, helping to identify and confirm the roles of these nodes under both maximal and more restricted interaction scenarios. The R code used for this analysis is available at https://osf.io/9kjsc/.

To reduce the complexity of the analysis in a second step, we employed a genetic algorithm (GA) to determine the best combination of items (Scrucca, 2013). Initial tests were conducted using a variety of item combinations generated by the GA to validate the selection approach. This analysis indicated that three items per motive was optimal. After these preliminary evaluations, the GA was applied more broadly across different item sets. This process ultimately identified the combinations of three items per motive that demonstrated the highest internal consistency.

A variety of network metrics were calculated (see Supplemental Material for description). The differences between groups of informants categorized by gender and age were estimated using Mahalanobis *D* (Del Giudice, 2022). Gender and age are basic demographic variables which are standard in the social sciences, and have well-known biological relevance as well (from an evolutionary theoretical point of view; we report gender rather than sex as this is what was recorded by informants). In addition, we also conducted generalized linear modelling for each motive to further explore the effects of gender and age in a multivariate analysis.

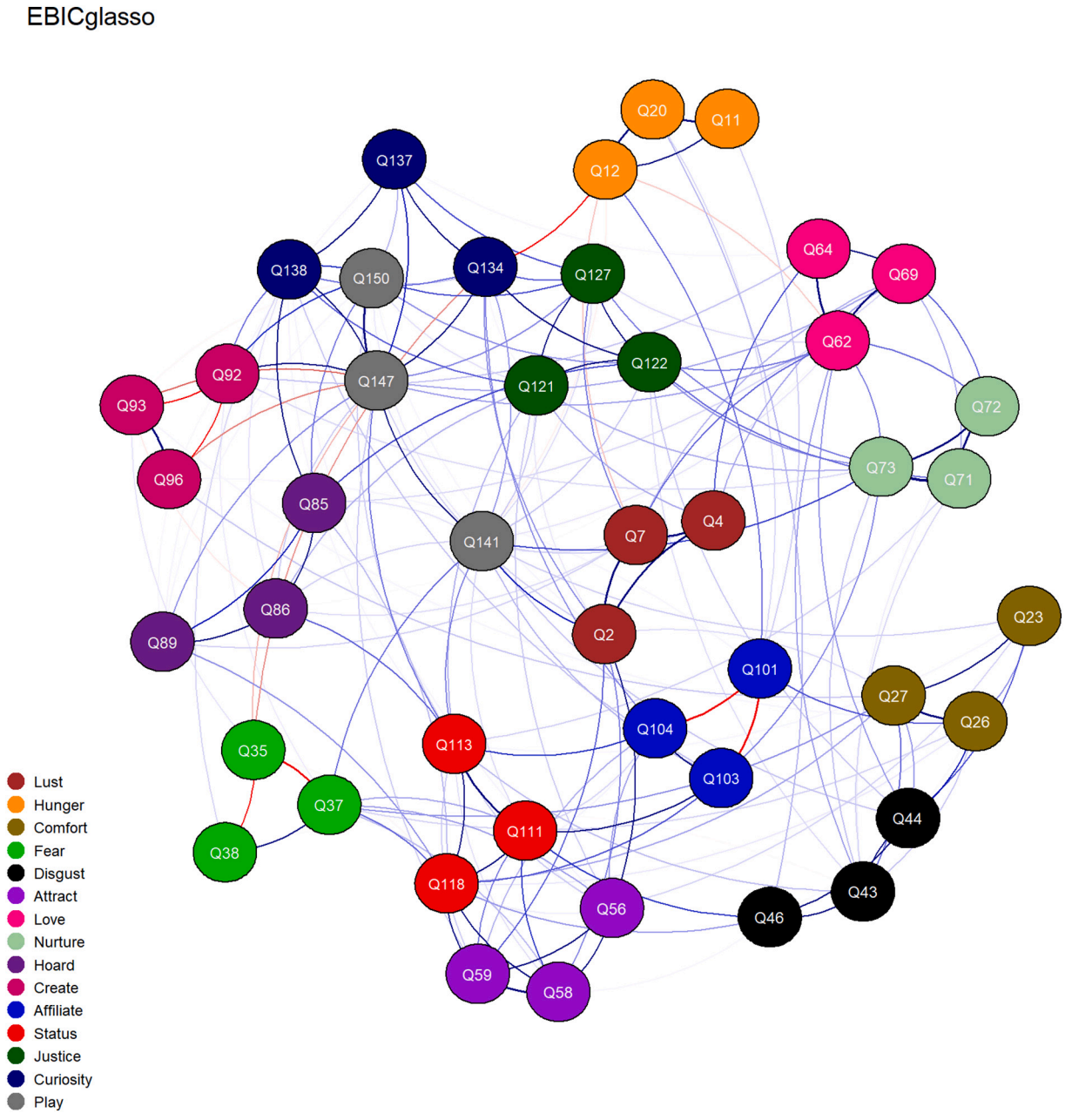

Fig. 2. Network plot of the selected items by evolved human motives ($N = 510$).

3. Results

3.1. Network analysis of the items by motive

In the network plot of 150 items categorized by motives, the visualization in Fig. 1 demonstrates how some items group according to their corresponding cluster, indicating strong intragroup connectivity that aligns with their designated motivational categories. Notably, nodes associated with categories like Nurture and Hunger exhibit dense clustering, suggesting high inter-item consistency within these specific motives. Conversely, other nodes appear more dispersed or have fewer connections, indicating either weaker associations within their respective categories or a broader cross-category influence. Additionally, some nodes do not show significant connectivity, either falling outside of major clusters or lacking connections altogether. This observation highlights the need for careful item selection to ensure that only those that truly represent their cluster are included in further analyses. A reduction to the three most characteristic items per motives was therefore undertaken using the GA.

3.2. Item selection

Fig. 2 presents the results of the network analysis conducted on the reduced set of items. Table 2 enumerates these items (which differ in some cases from those identified by factor loadings in Aunger et al., 2021). The indicators for Cronbach's α ranged from 0.53 to 0.83; on average, the alpha value was approximately 0.70. These values represent the highest achievable internal consistencies for each motive under the constraint of selecting three items per motive. This analysis reveals that the nodes, representing the items of the corresponding scales, form dense communities within their respective clusters.

3.3. Network analysis of the variables by motive

Fig. 3 presents a detailed network analysis that visualizes the relationships between various evolved human motives. The top half of the figure shows an unthresholded network, the lower half presents a thresholded network where only the strongest relationships are shown. The centrality measures panel on the right side of the figure quantitatively supports this observation, displaying network metrics such as betweenness, closeness, strength, and expected influence for each node. Stability plots are shown in Fig. 4, indicating that the measures are sufficiently stable.

All centrality metrics in both the unthresholded and thresholded network analyses highlight the prominent roles of the nodes representing Play and Status. These nodes appeared as pivotal points of connectivity, interacting extensively with other nodes, which suggests they influence a wide array of related motives, but are also crucial in the structuring and functioning of the motive network, acting as key hubs.

3.4. Gender differences

As shown in Table 3, the main differences between genders were seen in physiological and reproductive motives. Specifically, in physiological motives, women reported higher levels of interest in Comfort. In the realm of reproductive motives, significant disparities were evident: men exhibited higher levels of Lust, while women scored higher on Nurture. However, social motives displayed no significant differences, indicating similar valuations of relationships and fairness across both genders.

To further investigate these gender differences, we employed additional analyses related to the Mahalanobis *D* measure. This multivariate analysis disclosed a notable difference between men and women overall ($D = 1.170$), with the bootstrapped *CIs* of *D* ranging from 0.902 to 1.294. This robust variability highlights substantial distinctions in motivational profiles by gender. The probability that a randomly selected man scores higher than a woman on the combined variables was approximately

Table 2
Descriptive statistics and the list of the selected items for evolved human motives.

	α	*M* (*SD*)
Environmental		
Hoard	**0.53**	3.51 (0.71)
Q85 I always like to keep plenty of spare items around just in case I need them.		
Q86 I feel secure when I'm surrounded by stuff that might come in handy.		
Q89 I like to have complete sets of the things I collect.		
Create	0.70	3.30 (0.99)
Q92 I enjoy making things from scratch.		
Q93 I hate doing DIY at home. (*r*)		
Q96 I'm not much use at making things. (*r*)		
Physiological		
Fear	0.65	3.61 (1.11)
Q35 I would never go skydiving.		
Q37 I enjoy going on roller coasters. (*r*)		
Q38 I would happily swim with sharks. (*r*)		
Disgust	0.60	3.41 (0.93)
Q43 I would be disgusted to find mould on some food I was eating.		
Q44 Smelling milk that has gone off makes me nauseous.		
Q46 I would not eat any food that had passed its sell-by date.		
Hunger	0.80	3.62 (0.96)
Q11 Eating is less important to me than it seems to be for most people. (*r*)		
Q12 I don't really care much about food and drink. (*r*)		
Q20 I don't get much pleasure from eating. (*r*)		
Comfort	0.59	3.33 (0.99)
Q23 I am a very ticklish person.		
Q26 If I could I would spend all day in a cosy dressing gown.		
Q27 If I'm not meant to be anywhere I'll have a lie in.		
Reproductive		
Lust	0.82	3.61 (1.00)
Q2 I like to experiment with different genderual positions.		
Q4 The sheer pleasure of gender is one of life's great rewards.		
Q7 I hope I'll still be having gender regularly when I get old.		
Attract	0.73	2.21 (0.97)
Q56 My friends would say I'm a flirt.		
Q58 I like reading articles about how to attract a mate.		
Q59 I like to hang out where I might meet desirable partners.		
Love	0.76	3.91 (0.86)
Q62 I am happiest when I am with a person I love.		
Q64 I'd rather spend time with my partner than do anything else.		
Q69 Finding your ideal life partner is the best thing that can happen to you.		
Nurture	0.83	4.01 (0.95)
Q71 The smile of a child is one of the most beautiful things on the planet.		
Q72 Being a parent is the most important role one can play in life.		
Q73 Doing the little things that are needed to make sure a child is safe and secure give me satisfaction.		
Psychological		
Curiosity	0.60	3.71 (0.78)

(*continued on next page*)

Table 2 (*continued*)

	α	*M* (*SD*)
Q134 I am fascinated by going to places I haven't visited before.		
Q137 I always read to try and learn more about the world.		
Q138 I am interested in everything.		
Play	0.61	3.83 (0.67)
Q141 Having fun in whatever I do is important to me.		
Q147 I love to learn new skills.		
Q150 I enjoy contemplating new ideas.		
Social		
Affiliate	0.73	2.93 (1.01)
Q101 I don't have many friends. (*r*)		
Q103 I spend a lot of time keeping in contact with my friends.		
Q104 I can say I know a lot of people.		
Status	0.74	2.42 (0.94)
Q111 Much of what I do is designed to improve my social position.		
Q113 Holding a well-respected position in society is important to me.		
Q118 I enjoy showing off things that tell people I'm important.		
Justice	0.59	3.92 (0.67)
Q121 I would scold anyone who was inconsiderate to others.		
Q122 I get angry when I see someone take advantage of others.		
Q127 I am not afraid to stand up for the right thing.		

Note. *r* = reversed item.

79.6 % (*CL* = 0.796), accompanied by a fairly high probability of correct classification (*PCC* = 0.721). Furthermore, the overlap in group distributions (*OVL* = 0.559) and $H^2 = 0.83$ reflected the overall multivariate separation between groups, highlighting global patterns of difference. This analysis suggests that while some psychological and social behaviours do not show significant gender-based distinctions, key areas—particularly physiological and reproductive motives—display pronounced gender-specific patterns.

3.5. Age differences

Table 4 illustrates the main differences between age groups. As age rises, the values for Status (*ds* = 0.59–1.32) were lower. Furthermore, for the oldest age group, the values of - Comfort (*ds* = 0.94, 0.69), Attract (*ds* = 0.93, 0.60), Disgust (*ds* = 0.84, 0.40), Lust (*ds* = 0.50, 0.43), and Play (*ds* = 0.45, 0.41) were lower but Fear was higher (*ds* = −1.01, −0.76) than those in the younger and middle-aged groups. There was no evidence for any interaction effects between age and gender, except in the case of Love ($\omega^2 = 0.03$, $p < .001$). Older women were lower in Love motive compared to older men (*d* = 0.53) and middle-aged women (*d* = 0.64).

A further multivariate analysis of the Mahalanobis *D* revealed significant distinctions across age groups. Specifically, the largest difference was observed between the youngest (18–24) and oldest (50+) age groups (*D* = 2.268), with the bootstrapped *CI*s ranging from 1.753 to 2.483. The young group also showed notable differences when compared with the middle-aged group (25–49) with a *D* value of 1.088 and *CI*s ranging from 0.717 to 1.208. Similarly, comparisons between the middle-aged and old groups indicated notable differences (*D* = 1.307) with *CI*s from 1.037 to 1.454. These substantial variabilities underscore significant distinctions in how these age groups experience motives, with a particularly pronounced divergence between the youngest and oldest participants. The probabilities of correct classification among these comparisons were remarkably high (*CL* = 0.946, 0.779, and 0.822, and *PCC* = 0.872, 0.707, and 0.743, respectively), indicating a strong likelihood of distinguishing between groups based on their psychological profiles. The overlaps in group distributions (*OVL* = 0.257, 0.586, and 0.513, respectively) along with H^2 values (0.77, 0.75, and 0.74) indicated the multivariate separation across age groups, reflecting the overall pattern of differences.

4. Discussion

This paper focusses on the use of network-based analysis of psychometric data. The spatial relations and connectivity between motive clusters shown in Fig. 2 suggest some interesting conceptual linkages between the motives that mimic the conceptual groupings originally postulated for them due to functional similarities. Near neighbours (see also the correlations in Fig. 3) include: environmental motives (Create and Hoard), bodily-related motives (Comfort and Disgust), psychological motives (Curiosity and Play), familial (reproductive) motives (Love and Nurture), and social group-related motives (Affiliate and Status). Thus, Fig. 2 shows that the pre-identified theoretical categories of motives often function as super-clusters in this empirical analysis (at least in terms of pair-wise spatial proximity), presumably due to overlaps in the functioning of the constituent motives. The pairbond-related motives (Attract, Lust, and Love) have strong inter-group linkages, but spatially stretch across the figure (they are closer together in Fig. 1), probably due to connections with other motives (e.g., Love with Nurture, and Attract with Status). However, this kind of clustering might not illuminate the kinds of issues associated with individual differences in personality traits, since the higher-level categories are defined with respect to evolutionary function, not mental mechanisms or particular kinds of behaviour.

Other close relationships do not belong to the same category. For example, Justice has strong ties to Nurture and Curiosity, suggesting that it is a function of both concern for the welfare of others (related to, but an extension beyond, kin-based Nurture), and a need to keep abreast of where anti-social behaviours might be occurring (a consequence of Curiosity).

Fig. 3 also shows that most of the negative linkages in the motive network relate to Fear (negative connection with 6 motives: Comfort, Attract, Status, Create, Curiosity, Play), as would be expected from an approach-avoidance perspective on motivation (e.g., Elliot & Thrash, 2002), which looks to the behavioural proclivities to move toward or away from different classes of stimuli, depending on whether they are perceived as dangers or opportunities.

All the centrality measures (see Fig. 3) indicate that Play and Status play central roles in the overall structure of the network. For Play, the three items comprising the Play cluster range across a variety of different types of value (ideational/conceptual interests, embodied skills, and generalized 'fun') which link Play to different motives. Status seems to be important for another reason: it is functionally related to the achievement of other kinds of goals—that is, access to resources (the primary consequence of high status) facilitates gaining reproductive opportunities (Attract), but requires an elevated interest in Hoarding those resources, Fear of losing those resources to competitors, and acquiring the skills to maintain status (Play).

The results around gender differences are easily explained from an evolutionary point of view. Due to their higher obligatory investment in the gestation and (typically) raising of children (Bjorklund & Jordan, 2013), it is expected that women would demonstrate a higher level of interest in Nurture as a motive. Womens' interest in Comfort can be seen as being related to the traditional female concern with establishing a safe and facilitating domestic environment for the family (Cancian & Oliker, 2000). Males, on the other hand, have typically seen greater variation in reproductive success (Alberts, 2012), indicating a need to compete for mating opportunities—facilitated by a higher involvement with Lust as a motive.

The mean differences by age show patterns consistent with

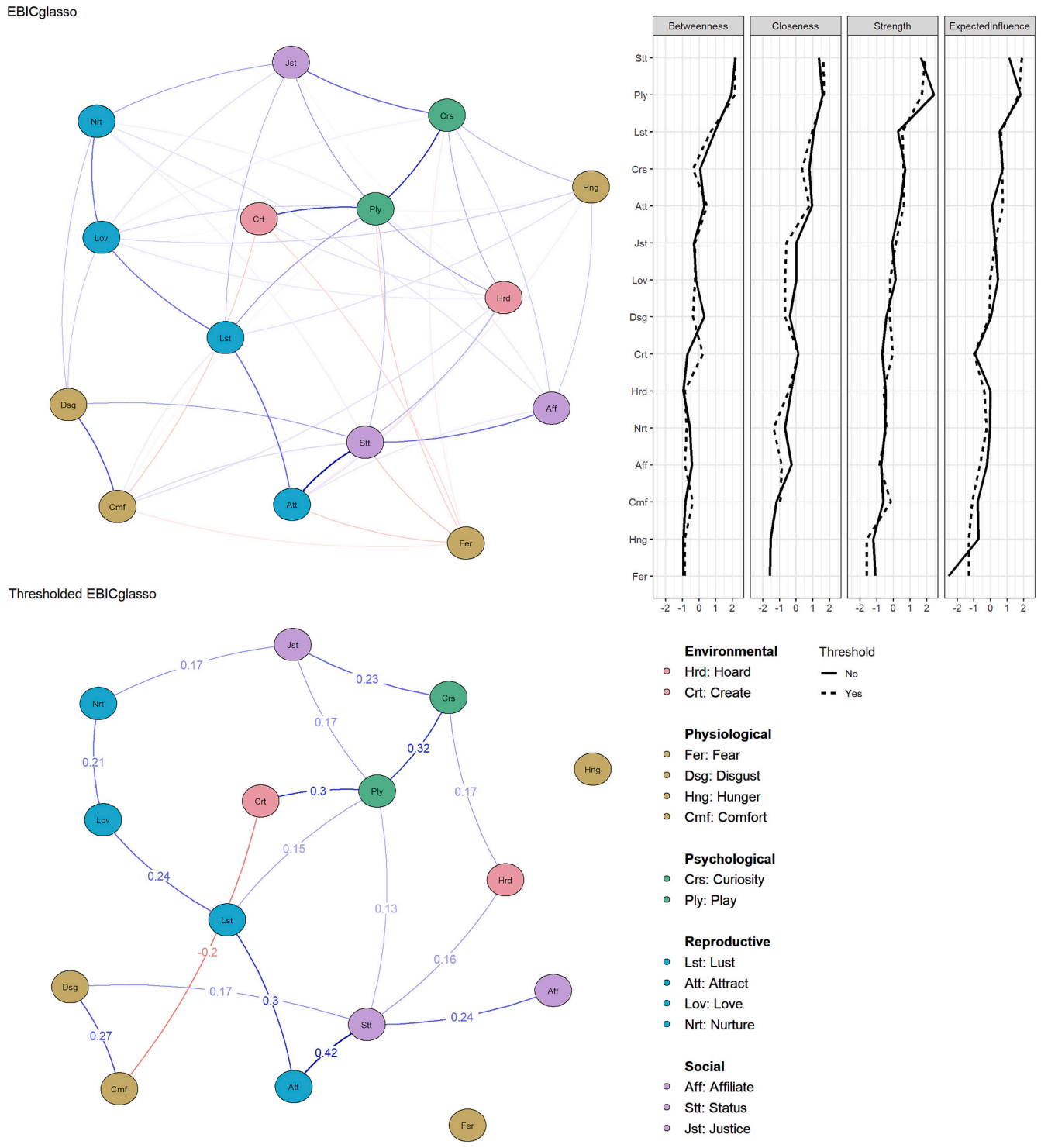

Fig. 3. Network plots and centrality measures plot of the variables by evolved human motives ($N = 510$).

evolutionary logic around life history. (Del Giudice et al., 2016; Kenrick & Griskevicius, 2015). In particular, toward the end of life, the 'Old' age class is composed of individuals who are less interested in learning new skills (Play), or being able to Attract mates, are less susceptible to feeling Disgust (i.e., are less worried about contracting diseases), or bothered with Lust (perhaps because post-reproductive) or Comfort (perhaps because they are more dependent on others for subsistence and other resources), but are more wary of environmental dangers (Fear), probably because they perceive themselves as more susceptible to injury and environmental insults. On the other hand, the 'Young' age class are more concerned with gaining social Status (i.e., getting a competitive 'upper hand' with respect to valuable resources and social influence), being close to the start of their life's career. These differences signify a nuanced evolution in priorities across various stages of life.

Finally, while our earlier, factor-analytic approach to this data showed low internal reliability and lack of discriminant validity for some motives (such as Attract and Lust), these motives showed reasonable validity in new analyses, and proved to vary by gender and age here, indicating identifiably different patterns of response in this analysis. Our prior work also did not result in a well-defined Comfort

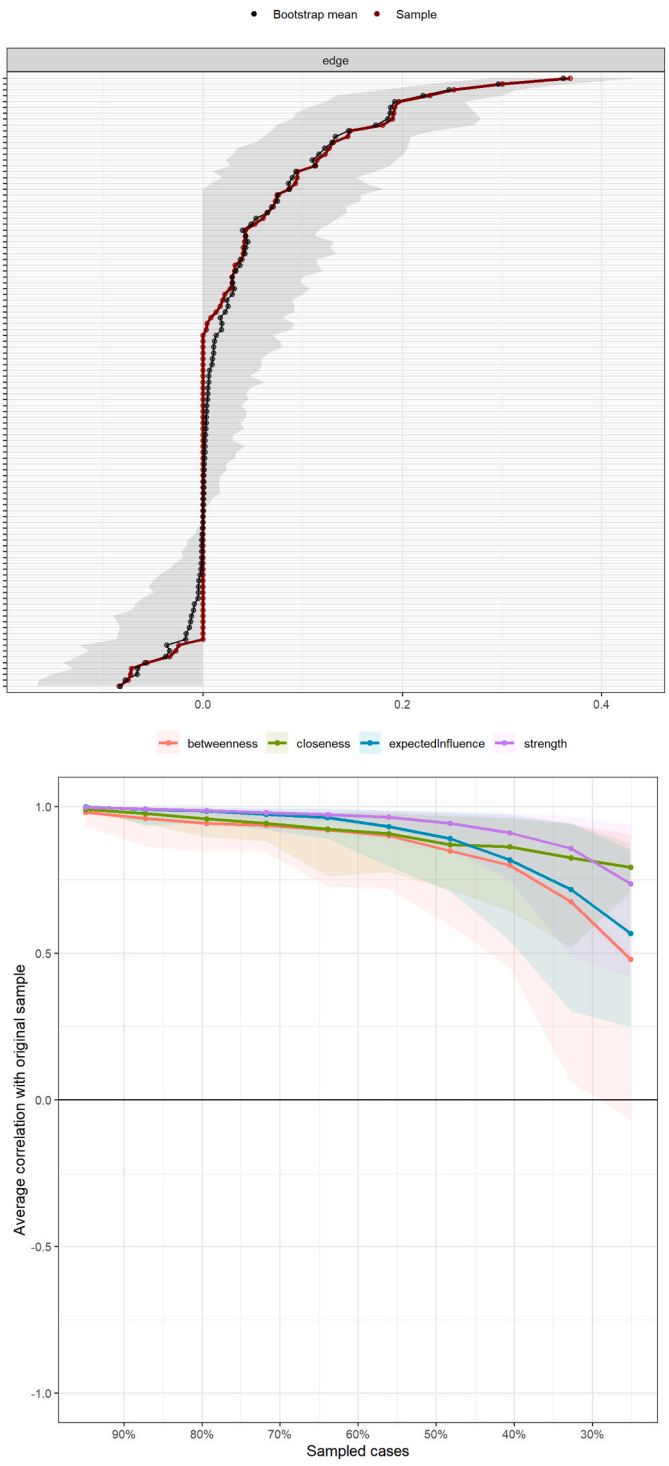

Fig. 4. Stability plots for the network and centrality measures of the variables by evolved human motives ($N = 510$).

factor, but the fact that such a variable was identified in this network-based analysis, and also showed meaningful variation by gender, suggests that this analysis was better able to identify significant differences in response patterns with respect to this variable as well.

4.1. Limitations

While this study marks a crucial step in understanding evolved human motives, several limitations should be considered. First, this research is exploratory, using pre-existing data without preregistered hypotheses, which may introduce post hoc interpretations that align with our pre-defined theoretical perspective. Additionally, the sample is drawn from a UK population, limiting the generalizability of the findings to other cultural contexts. Moreover, the wording of psychometric items, while carefully crafted, may require refinement to ensure clarity and consistency across diverse groups.

4.2. Future directions

Future studies could use the reduced item list as a scale to test these findings across diverse cultures and thus judge their generalizability. Additionally, there is potential to apply the identified motives in various fields, such as education, marketing, and human relations, where

Table 3
Marginal means for gender differences in evolved human motives ($N = 510$).

	Men ($n = 244$)	Women ($n = 266$)	d
Environmental			
Hoard	3.64	3.47	−0.23
Create	3.37	3.26	−0.11
Physiological			
Fear	3.46	3.46	−0.01
Disgust	3.41	3.66	0.29
Hunger	3.45	3.59	0.14
Comfort	3.21	**3.63**	0.49**
Reproductive			
Lust	**3.90**	3.42	−0.50***
Attract	2.51	2.19	−0.35
Love	3.88	3.84	−0.04
Nurture	3.66	**4.15**	0.53***
Psychological			
Curiosity	3.80	3.70	−0.12
Play	3.89	3.81	−0.12
Social			
Affiliate	2.96	2.94	−0.02
Status	2.81	2.52	−0.32
Justice	3.80	3.92	0.18

Note. ***$p < .001$, **$p < .01$. Values with higher means are highlighted in bold. The Mahalanobis D summarizing the overall distance in evolved human motives between males and females was 1.17.

Table 4
Marginal means for age differences in evolved human motives (N = 510).

	Young – 18-24 ($n = 57$)	Middle – 25-49 ($n = 219$)	Old – 50 + ($n = 234$)	ω^2
Environmental				
Hoard	3.67_a	3.55_a	3.45_a	0.01
Create	3.29_a	3.43_a	3.24_a	0.01
Physiological				
Fear	3.01_a	3.30_a	$\mathbf{4.08}_b$	0.10***
Disgust	$\mathbf{3.91}_a$	$\mathbf{3.52}_a$	3.18_b	0.04***
Hunger	3.35_a	3.58_a	3.64_a	0.01
Comfort	$\mathbf{3.78}_a$	$\mathbf{3.55}_a$	2.94_b	0.08***
Reproductive				
Lust	$\mathbf{3.84}_a$	$\mathbf{3.78}_a$	3.36_b	0.03***
Attract	$\mathbf{2.74}_a$	$\mathbf{2.43}_a$	1.87_b	0.07***
Love	3.91_a	3.92_a	3.75_a	0.01
Nurture	3.76_a	3.91_a	4.04_a	0.01
Psychological				
Curiosity	3.89_a	3.69_a	3.67_a	0.01
Play	$\mathbf{3.96}_a$	$\mathbf{3.93}_a$	3.66_b	0.03***
Social				
Affiliate	3.01_a	3.00_a	2.84_a	.01
Status	$\mathbf{3.27}_a$	2.62_b	2.10_c	0.09***
Justice	3.73_a	3.89_a	3.96_a	0.01

Note. ***$p < .001$. Significant differences at the $p < .05$ level are denoted by differing Latin letters. Values with higher means are highlighted in bold. The Mahalanobis D summarizing the overall distance in evolved human motives between young and middle-aged individuals was 1.09, between young and old individuals was 2.27, and between middle-aged and old individuals was 1.31.

understanding motivational profiles can lead to more effective strategies (e.g., of hiring new personnel based on compatibility between that profile and job requirements) and interventions (e.g., by matching the motivation triggered by an ad with that causing product purchase). Indeed, we have ourselves initiated this kind of application in other work on motivational profiling for public health intervention design (e.g., Czerniewska et al., 2019). As the research progresses, it will be important to investigate how these motives interact with situational factors to shape behaviour, paving the way for more dynamic and context-sensitive models of human motivation.

5. Conclusion

This paper presents an analysis of data collected from residents of the UK, in which all 15 of a nominated set of evolved human motives were identified using network-based psychometric techniques. This analysis differs from most psychometric analyses in using pre-identified rather than post-hoc items, based on reasoning from evolutionary theory about the kinds of needs that people would have to fulfil, given the human way of life. The network structure among motives also proved to be of interest. Essentially, functionally related motives (e.g., having a focus on improvement of the environment or achieving social goals) cluster together in this analysis. Gender differences in concern for specific motives followed patterns expected from the traditional roles played by the genders in our evolutionary past. The reduced set of 45 items arising from this analysis could form the basis of a psychometric scale for human motivation research. Independent work has shown that the same suite of motives can be used to ascertain people's different levels of satisfaction in the distinct spheres of life encapsulated by each motive (Joshanloo, 2023). Knowing the complete set of motives behind goal-directed behaviour should prove a significant boon to a wide variety of applications of psychology, such as human relations, educational strategies, marketing and behaviour change.

Open practices statement

The dataset is available on Open Science Framework (OSF) https://osf.io/njkcq/.

CRediT authorship contribution statement

Robert Aunger: Writing – review & editing, Writing – original draft, Supervision, Project administration, Investigation, Data curation, Conceptualization. **Albina Gallyamova:** Writing – original draft, Validation, Investigation, Conceptualization. **Dmitry Grigoryev:** Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Conceptualization.

Ethics statement

This study was conducted in compliance with the ethical standards of COPE and APA. The data collection, conducted by the London School of Hygiene and Tropical Medicine and approved by its Ethics Committee (internal application number 17858; approval date: November 25, 2019).

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Declaration of competing interest

The authors declare they have no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2024.112921.

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